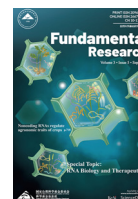
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Editorial

RNA biology and therapeutics

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Eukaryotic genomes undergo pervasive transcription, generating vast amounts of noncoding RNAs alongside protein-coding mRNAs [1]. These noncoding RNAs, including small noncoding RNAs, long noncoding RNAs (lncRNAs), and circular RNAs, have been shown to play critical roles in gene regulation, chromatin remodeling, assembly of membraneless organelles, and other essential biological processes. They function through a diverse range of mechanisms [2–5]. Dysregulation of noncoding RNAs contributes to human disease pathogenesis and affects plant development and stress response [6–8]. Over the past decade, significant progress has been made in unraveling the functions of noncoding RNAs and elucidating the molecular mechanisms by which they operate. The involvement of noncoding RNAs in human disease pathogenesis and agronomic trait regulation has garnered increasing attention.

RNA molecules can fold into secondary and tertiary structures via Watson–Crick, Hoogsteen, or wobble base pairing [9]. The functions of many regulatory RNAs depend on the formation of these structures and their ability to adapt to cellular conditions [10]. Mutations that disrupt RNA structures are associated with various human diseases, including neurodegenerative diseases [11]. However, determining and modeling RNA structures, particularly tertiary structures, remains a significant challenge due to their inherent flexibility.

RNA molecules undergo modifications by various chemical groups, with over 160 types of RNA modifications currently identified [12]. Investigation into several abundant RNA modifications has revealed that RNA modifications, such as the internal mRNA modification N6-methyladenosine (m6A), regulate RNA metabolism and are involved in various cellular, developmental, and disease processes [13–15]. In recent years, efforts have been made to develop high-throughput methods for profiling different RNA modifications, especially non-abundant ones. Such efforts have enabled the identification of writers, readers, and erasers, thereby broadening our understanding of the diverse biological roles played by various RNA modifications.

Our growing understanding of the functions of different types of RNAs and their crucial roles in pathogenesis promotes the rise and development of RNA-based therapeutics. They have the potential to revolutionize future disease treatment as they can target proteins, transcripts, or genes that are beyond the reach of conventional drugs. RNA-based therapeutics can be based on mRNA, antisense RNA, RNA

interference (RNAi), and RNA aptamers [16]. In the early 2010s, RNA-based cancer therapy had significant progress [17]. This success continued with the development of mRNA vaccines targeting SARS-CoV-2, which have proven to be highly effective in saving numerous lives [18]. However, there are still many RNA-based therapeutics under development that have not been used clinically. The main challenges in this field include improving RNA metabolic stability, enhancing the efficiency and specificity of RNA delivery, and attaining minimal immunogenicity.

This special issue of *Fundamental Research* focuses on RNA biology and therapeutics, presenting a collection of one perspective, nine review articles, and one original research article. Zou et al. [19] bring to our attention new regulatory functions of RNA, while Yin et al. [20] review the functions and mechanisms of chromatin-bound RNAs. Gou et al. [21], Liu et al. [22], and Zhu et al. [23] discuss the contribution of dysregulated noncoding RNAs to human diseases, including tumorigenesis and inflammation. In their review, Xu et al. [24] explore miRNA biogenesis pathways in plants, and Zhang et al. [25] summarize the roles of noncoding RNAs in regulating agronomic traits. Shu et al. [26] introduce a new technique, a⁶A-seq, which allows for the examination of RNA dynamics. Deng et al. [27] review the technical advances in RNA structural analysis, while Li et al. [28] cover the role of mRNA modifications and advancements in mRNA modification detection. Finally, Wei et al. [29] provide a comprehensive review of the current status of mRNA-based therapeutics, discussing potential future directions for improvement. These articles offer valuable insights and are expected to inspire further research in the exciting fields of RNA biology and RNA-based therapeutics.

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